

July 15, 1964

TITLE:

Summary of Microdensitometer Derived Image Quality Data Collected from Mission 1006-2

SECTION I: INTRODUCTION

Microdensitometer tracing of scene edges has been used as an objective technique for evaluating photographic system performance. In this report, the evaluation data is presented as spread function width in microns and resolving power in lines per millimeter. A statistical summary of the edge data is presented in Section II, giving the arithmetic mean, standard deviation, coefficient of dispersion, and number of edges. Section III is a tabulation of the location, description, and image quality data for each edge. Frequency plots of the spread function and resolving power data are presented as Section IV, to show the distribution of values. Section V is included to show the sensitometric data for this mission. A diagram of the reference system used in describing the orientation of an edge and a temporary coordinate system used to locate the edges within a frame are presented as Appendix A.

STAT The image quality data was obtained from sharp scene edges in the original negative by scanning with a Model 5 microdensitometer. A 1 X 320 micron slit was used. The data reduction consisted of the following steps:

- (a) hand smoothing of the microdensitometer strip chart recording,
- (b) key punching of chart (density) values at sample distance increments of 0.277 microns,
- (c) I.B.M. 1620 computer conversion of chart values to relative exposure values, and
- (d) computer conversion of exposure data to line spread function and modulation transfer function by numerical methods.

The edge resolving power was predicted graphically as the intersection of the MTF curve and the aerial image modulation curve for 4404 film at a test object contrast of 2:1. The spread function width was calculated from the first differences of relative exposure as the width at which the gradient became 50% of the maximum gradient.

Declass Review by NGA.

Analysis of Photographic Image to Evaluate System Performance

SECTION II SUMMARY SHEET

Mission 1006-2

Resolution in lines/mm based on the aerial image modulation - 4404 curve from edge trace data reduced by computer techniques.

Arithmetic Mean	85.5
Standard Deviation	22.1
Coefficient of Dispersion	26%
Number of edges	109

Spread function width at 50% amplitude in microns from edge trace data reduced by computer techniques.

Arithmetic Mean	11.4
Standard Deviation	3.3
Coefficient of Dispersion	29%
Number of Edges	109

Analysis of Photographic Image to Evaluate System Performance

Mission 1006-2

Section III

<u>Edge No.</u>	<u>Camera</u>	<u>Pass</u>	<u>Frame</u>	<u>Location</u>	<u>Orientation</u>	<u>Subject</u>	50% Amplitude Spread Function Width (Microns)	<u>A.I.M. Resolution</u>
1	Aft.	D70	051	A-3	165	Airfield	14.3	59
1A	Aft.	D70	051	A-3	165	Airfield	12.3	105
2	Fwd	D73	044	B-11	005	Airfield	10.7	126
2A	Fwd	D73	044	B-11	005	Airfield	12.6	70
3A	Fwd	D73	028	A-6	175	Airfield	6.8	121
4	Fwd	D73	028	B-12	148	Airfield	11.8	70
5A	Fwd	D73	027	B-8	000	Airfield	9.2	90
6	Fwd	D73	008	B-14	168	Airfield	12.4	93
6A	Fwd	D73	008	B-14	168	Airfield	9.7	101
7	Fwd	D73	004	A-10	068	Airfield	6.1	134
7A	Fwd	D73	004	A-10	068	Airfield	10.4	116
8	Fwd	D73	002	C-11	137	Airfield	16.7	52
8A	Fwd	D73	002	C-11	137	Airfield	12.9	73
9	Aft.	D73	041	B-11	140	Airfield	8.4	98
10	Aft.	D73	032	A-9	180	Airfield	7.5	116
10A	Aft.	D73	032	A-9	180	Airfield	13.9	63
11	Aft.	D73	032	C-7	090	Airfield	8.4	97
11A	Aft.	D73	032	C-7	090	Airfield	10.8	78
12	Aft.	D73	023	C-2	160	Airfield	9.9	88
12A	Aft.	D73	023	C-2	160	Airfield	10.3	66

-2-

<u>Edge No.</u>	<u>Camera</u>	<u>Pass</u>	<u>Frame</u>	<u>Location</u>	<u>Orientation</u>	<u>Subject</u>	50% Amplitude Spread Function Width (Microns)	A.I.M. Resolution
13A	Aft.	D73	012	A-11	055	Bridge	14.6	54
14	Aft.	D73	012	B-11	072	Break- water	27.9	54
14A	Aft.	D73	012	B-11	072	Break- water	21.9	41
15	Aft.	D73	009	B-C-4	060	Airfield	10.0	86
15A	Aft.	D73	009	B-C-4	060	Airfield	11.5	86
16	Aft.	D73	009	A-3	038	Airfield	9.9	90
16A	Aft.	D73	009	A-3	038	Airfield	9.5	118
17A	Aft.	D73	007	A-3	130	Airfield	14.6	64
18	Aft.	D73	006	B-C-2	092	Airfield	12.5	68
18A	Aft.	D73	006	B-C-2	092	Airfield	12.4	72
19	Aft.	D73	005	B-5	145	Airfield	10.3	86
19A	Aft.	D73	005	B-5	145	Airfield	10.6	90
20	Fwd.	D103	033	B-C-4	072	Airfield	13.7	102
20A	Fwd.	D103	033	B-C-4	072	Airfield	10.2	75
21	Aft.	D99	076	A-B-1	075	Airfield	13.5	70
21A	Aft.	D99	076	A-B-1	075	Airfield	10.4	84
22A	Aft.	D87	094	B-1	025	Airfield	9.5	85
23	Aft.	D87	093	A-8	072	Airfield	16.4	58
23A	Aft.	D87	093	A-8	072	Airfield	9.9	93
24	Fwd.	D87	071	B-C-14	125	Airfield	14.4	57
24A	Fwd.	D87	071	B-C-14	125	Airfield	15.2	54

-3-

<u>Edge No.</u>	<u>Camera</u>	<u>Pass</u>	<u>Frame</u>	<u>Location</u>	<u>Orientation</u>	<u>Subject</u>	50% Amplitude Spread Function Width (Microns)	<u>A.I.M. Resolution</u>
25	Fwd	D87	055	A-7	175	Bridge	9.6	97
25A	Fwd	D87	055	A-7	175	Bridge	8.5	103
26	Fwd	D87	090	A-6	068	Airfield	17.3	56
26A	Fwd	D87	090	A-6	068	Airfield	14.0	81
27	Fwd	D87	090	C-13	022	Airfield	15.0	52
27A	Fwd	D87	090	C-13	022	Airfield	15.0	56
28	Fwd	D87	091	A-13	022	Airfield	14.0	63
28A	Fwd	D87	091	A-13	022	Airfield	18.7	59
29	Fwd	D68	070	A-2	000	Airfield	9.1	101
29A	Fwd	D68	070	A-2	000	Airfield	9.5	95
30	Fwd	D100	013	A-8	000	Airfield	12.9	64
30A	Fwd	D100	013	A-8	000	Airfield	12.8	67
31	Fwd	D100	013	C-9	105	Airfield	10.7	86
31A	Fwd	D100	013	C-9	105	Airfield	14.0	58
32A	Fwd	D100	015	A-10	090	Airfield	6.5	135
33	Fwd	D100	016	E-13	025	Airfield	7.8	120
33A	Fwd	D100	016	E-13	025	Airfield	8.6	112
35	Fwd	D100	022	C-4	070	Airfield	12.4	70
35A	Fwd	D100	022	C-4	070	Airfield	12.3	71
36	Fwd	D100	023	C-4	090	Airfield	13.0	66
36A	Fwd	D100	023	C-4	090	Airfield	12.8	62
37	Fwd	D100	023	E-5	080	Airfield	12.3	76
37A	Fwd	D100	023	E-5	080	Airfield	9.7	90

-4-

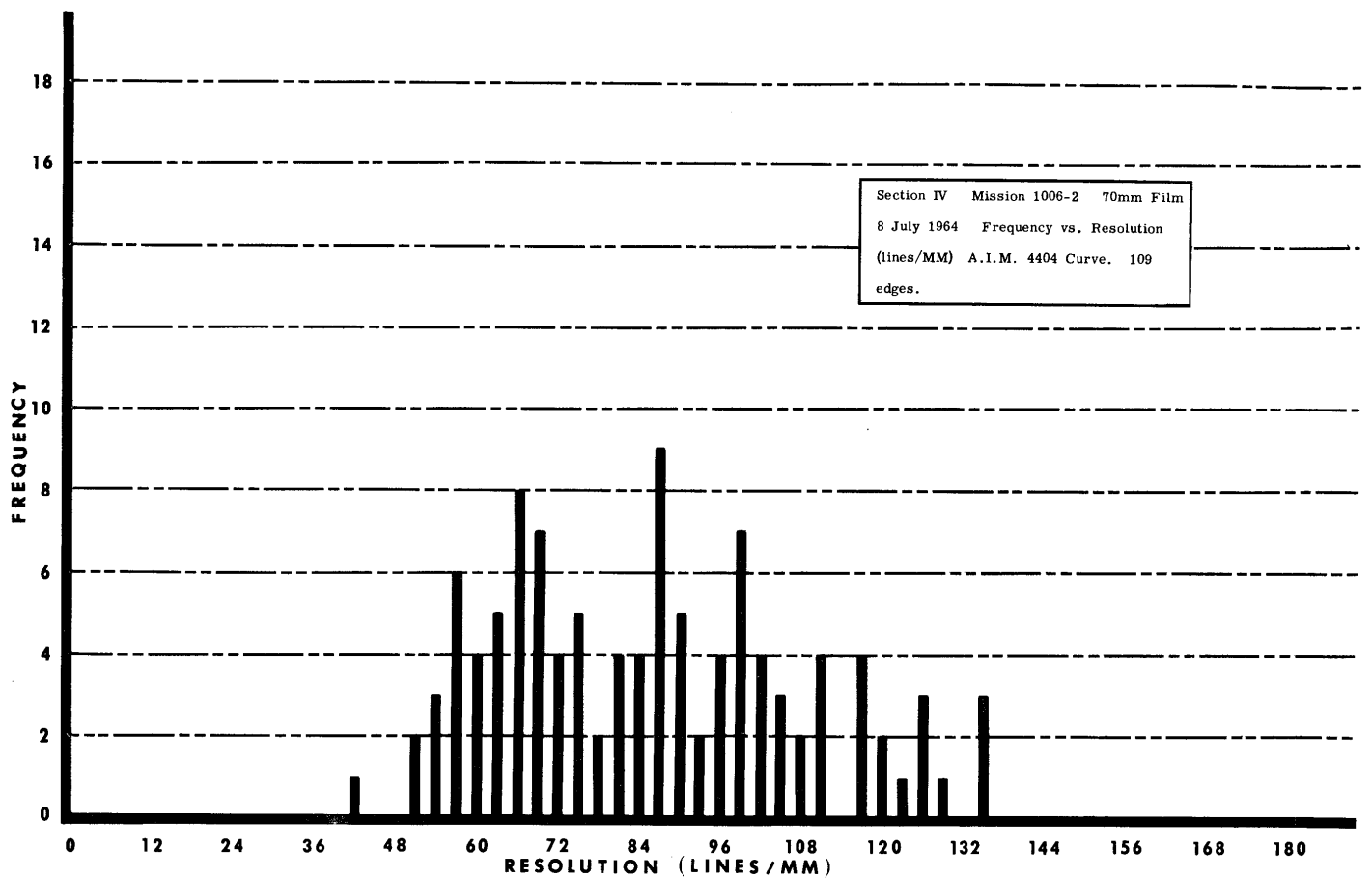
<u>Edge No.</u>	<u>Camera</u>	<u>Pass</u>	<u>Frame</u>	<u>Location</u>	<u>Orientation</u>	<u>Subject</u>	50% Amplitude Spread Function Width (Microns)	<u>A. I. M. Resolution</u>
38	Fwd	D100	024	A-4	080	Airfield	12.2	67
38A	Fwd	D100	024	A-4	080	Airfield	12.2	67
39	Aft.	D119	103	B-2	035	Airfield	14.2	85
40	Aft.	D119	096	B-C-7-8	025	Airfield	12.3	71
40A	Aft.	D119	096	B-C-7-8	025	Airfield	12.9	66
41	Aft.	D119	096	B-6	022	Airfield	11.0	83
41A	Aft.	D119	096	B-6	022	Airfield	6.6	125
43A	Aft.	D119	095	A-6	115	Airfield	10.0	105
44	Aft.	D119	090	B-6	095	Airfield	6.9	135
44A	Aft.	D119	090	B-6	095	Airfield	6.4	129
45	Aft.	D119	060	A-6	020	Break- water	13.4	67
48	Fwd	D119	082	B-3	180	Private airfield	9.4	87
48A	Fwd	D119	082	B-3	180	Private airfield	8.9	99
49	Fwd	D119	091	B-8	170	Airfield	10.9	80
49A	Fwd	D119	091	B-8	170	Airfield	9.6	110
50	Fwd	D119	091	C-8	100	Break- water	12.4	88
51	Fwd	D119	092	B-7	020	Airfield	12.2	69
51A	Fwd	D119	092	B-7	020	Airfield	12.9	70
52	Fwd	D119	092	A-8	020	Airfield	12.9	105
52A	Fwd	D119	092	A-8	020	Airfield	8.6	111
54	Fwd	D119	099	A-B-11	030	Airfield	15.0	60

-5-

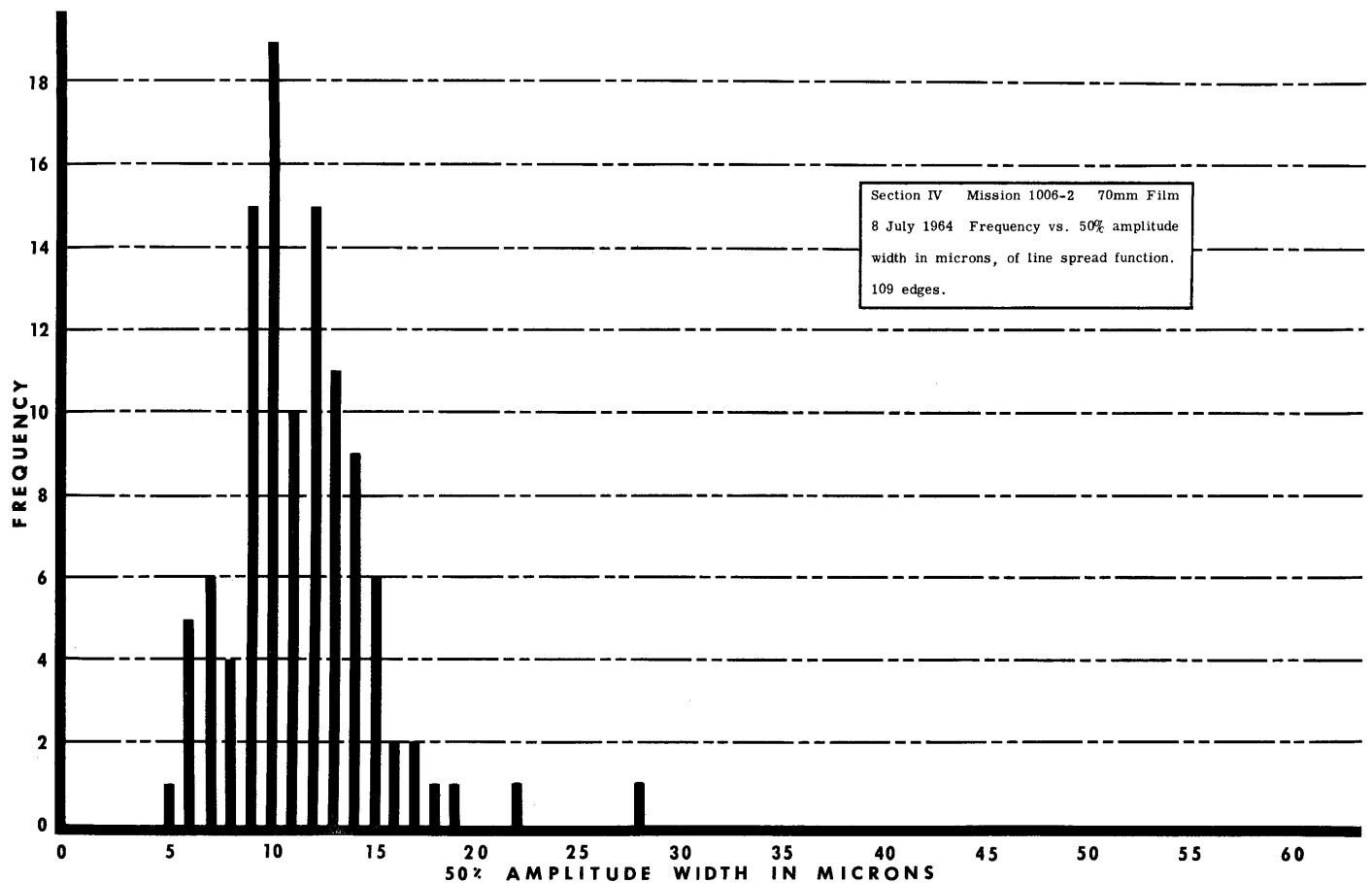
<u>Edge No.</u>	<u>Camera</u>	<u>Pass</u>	<u>Frame</u>	<u>Location</u>	<u>Orientation</u>	<u>Subject</u>	50% Amplitude Spread Function Width (Microns)	<u>A.I.M. Resolution</u>
54A	Fwd	D119	099	A-B-11	030	Airfield	11.7	74
55	Aft.	D100	040	B-6	040	Airfield	8.9	100
55A	Aft.	D100	040	B-6	040	Airfield	9.7	98
57	Aft.	D100	031	C-8	150	Building	8.6	96
57A	Aft.	D100	031	C-8	150	Building	6.3	122
58	Aft.	D100	028	A-9	080	Airfield	10.9	87
58A	Aft.	D100	028	A-9	080	Airfield	7.0	112
59	Aft.	D100	028	C-10	060	Airfield	11.8	74
60	Aft.	D100	026	B-10	030	Airfield	17.8	59
60A	Aft.	D100	026	B-10	030	Airfield	10.0	98
61	Aft.	D100	020	A-4	080	Airfield	10.3	109
61A	Aft.	D100	020	A-4	080	Airfield	7.8	76
62	Aft.	D100	019	B-6	015	Airfield	10.5	108
62A	Aft.	D100	019	B-6	015	Airfield	9.5	98
64	Aft.	D100	018	B-7	005	Airfield	11.5	79
64A	Aft.	D100	018	B-7	005	Airfield	10.2	90
65	Aft.	D100	028	A-9	160	Airfield	6.4	125
65A	Aft.	D100	028	A-9	160	Airfield	11.5	87
66	Aft.	D56	067	C-1	020	Airfield	5.5	67
66A	Aft.	D56	067	C-1	020	Airfield	15.7	57
67	Aft.	D56	068	A-9	050	Airfield	10.5	81
67A	Aft.	D56	068	A-9	050	Airfield	9.2	98

-6-

<u>Edge No.</u>	<u>Camera</u>	<u>Pass</u>	<u>Frame</u>	<u>Location</u>	<u>Orientation</u>	<u>Subject</u>	50% Amplitude Spread Function Width (Microns)	<u>A.I.M. Resolution</u>
69	Aft.	D103	133	A-8	070	Settling bed	9.0	82
69A	Aft.	D103	133	A-8	070	Settling bed	7.3	116



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Section V Page 1

Sensitometric Data

Mission 1006-2

Film Manufacturer:

STAT

Exposure Date: May 26, 1964

Emulsion No.: 4404-42

Lamp No.: 1903

Exposure Time: 1/25 second

Wedge No.: 711-15

Filter: Daylight

Development Conditions:

Primary: PG - 93, 2' 15", 74⁰F

Intermediate: Primary Development Plus 12DX90, 25", 67⁰F

Full: Primary Development Plus 12DX90, 1' 41", 67⁰F

Absolute Log E 11th Step: 1.30 M.C.S.

Section V Page 2

Sensitometric Data

	Process Control Standard			Start Up		
	Primary	Intermed.	Full	Primary	Intermed.	Full
Fog	.08	.10	.19	.07	.09	.19
1						
2						
3						
4						.19
5			.19			.20
6		.10	.20		.10	.21
7	.08	.12	.23	.08	.12	.24
8	.10	.14	.27	.09	.14	.30
9	.12	.18	.34	.13	.20	.38
10	.16	.26	.50	.18	.28	.56
11	.24	.42	.79	.26	.44	.82
12	.38	.67	1.10	.42	.69	1.14
13	.62	1.03	1.43	.66	1.12	1.46
14	.93	1.40	1.72	.94	1.41	1.74
15	1.26	1.71	1.95	1.30	1.73	1.99
16	1.55	1.95	2.13	1.63	1.99	2.18
17	1.83	2.10	2.24	1.90	2.19	2.31
18	2.04	2.22	2.30	2.11	2.28	2.41
19	2.17	2.29	2.35	2.24	2.35	2.44
20	2.25	2.34	2.39	2.33	2.37	2.47
21	2.30	2.37	2.43	2.39	2.40	2.50
f	2.15	2.38	2.20	2.15	2.37	2.20
0.6G/Speed	1.48	1.30	1.13	1.13	1.34	1.49

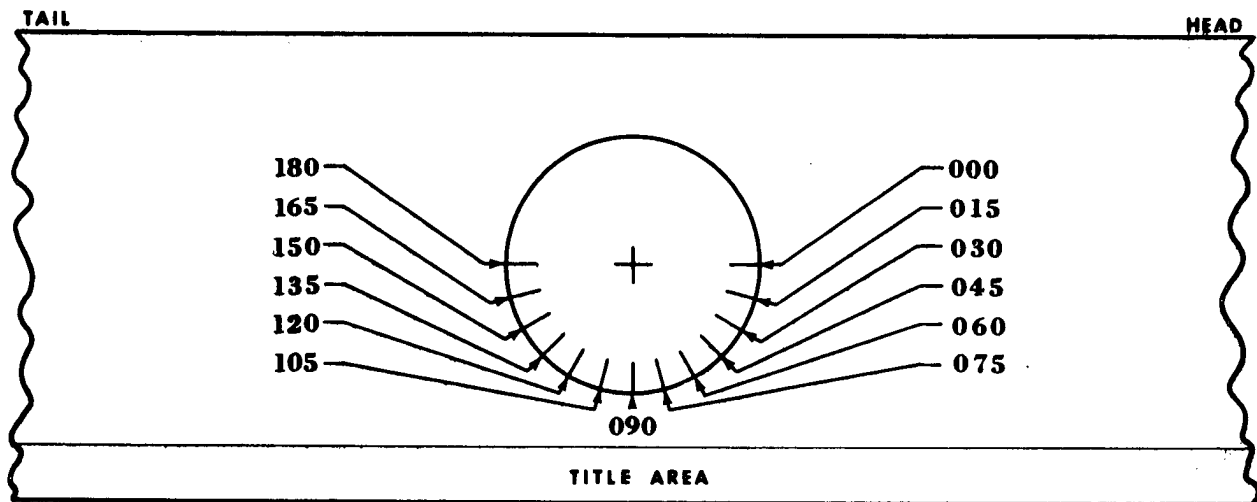
Section V. Page 3

	Head and Tail		Head and Tail		Mission
	Forward Camera		Aft Camera		Mat'l
	Head	Tail	Head	Tail	Full
Fog	.19	.19	.19	.18	
1					
2					
3					
4	.19	.18	.19	.18	.21
5	.20	.19	.20	.19	.22
6	.21	.20	.21	.20	.24
7	.23	.22	.23	.23	.27
8	.30	.27	.29	.29	.34
9	.40	.38	.38	.39	.45
10	.58	.56	.59	.58	.63
11	.83	.82	.84	.84	.91
12	1.15	1.15	1.13	1.14	1.20
13	1.48	1.48	1.49	1.48	1.47
14	1.76	1.78	1.78	1.78	1.76
15	2.01	2.02	2.01	2.02	1.97
16	2.20	2.21	2.20	2.20	2.15
17	2.32	2.32	2.32	2.33	2.28
18	2.40	2.40	2.40	2.40	2.36
19	2.44	2.45	2.43	2.44	2.42
20	2.46	2.48	2.44	2.46	2.43
21	2.49	2.49	2.46	2.48	2.44
8	2.15	2.18	2.11	2.12	1.97
0.6G/Speed	1.12	1.11	1.09	1.12	1.07

APPENDIX "A"

Reference System For Orientation Of C/M/J Mission Edges

original negative - - emulsion up



Grid For Position Of C/M/J Mission Edges

original negative - - emulsion up

